

From Signals to Symbols : Grounding Language Origins in
Communication Games

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From Signals to Symbols : Grounding Language Origins in Communication Games

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This chapter brings together the fields of economics and linguistics on the topic of language origins. It concerns properties of human language, particularly how linguistic signs or symbols have inherited design features present in linguistic communication . I will show how some features of language can be adequately understood as a result of coordination games. I will argue that modern language originated as a consequence of trade relationships and the division of labor involved by early humans around 40.000 years ago. As an economic activity, both trade (or exchange) relationships and division of labor call for coordination. The outcome is that games and economic behavior have a significant causal relationship to some general properties of the linguistic symbol.

4.1 Adam Smith's dog

Language and economics have been related since at least Adam Smith's reflections on the origin of the division of labor. Smith attributes the division of labor to language or the faculty of reason. In his *Wealth of Nations* of 1776. Smith writes :

The division of labour , from which so many advantages are derived, is not originally the effect of any human wisdom,..., it is the necessary consequence of a certain propensity in human nature : the propensity to truck, barter, and exchange one thing for another ... This propensity ... seems to be the necessary consequence of the faculties of reason and speech. (Smith, 1776, p. 25)

Smith goes on to assert that this propensity is unique to man, thus writing these famous words:

No body ever saw a dog make a fair and deliberate exchange of one bone for

another with another dog. (Smith, 1776, p.26)

According to Smith's , the division of labor, the exchange of goods and language could all be causally related . The division of labor produces a diversity of goods that could be exchanged. The exchange of goods creates the necessity of a contract, and contracts require concerted or coordinated actions among the contracting individuals. In coordinated actions , agents are involved in communication games whereby they convey the information required for the exchange. A symbolic and complex language then subserves the communication of information.

Modern linguistics as has also adopted a view that appeals to economics and even political theory and political philosophy. Let me mention Ferdinand de Saussure who in his *Cours de Linguistique Générale* of 1916 asserted that the linguistic signs, or "*la langue* ", had originated in a social contract: " *There is a language — Sassure says* ¹ -- *only in virtue of a kind of social contract handed on among members of a community* " Moreover, the Swiss linguist was the first to establish that language was comprised of interrelated signs that form a system. The saussurean sign is a one-to-one mapping from meaning to sound that is lodged in the brains of at least two speakers. All individuals bound by language, Saussure avows ,reproduce the same sounds ² mapped onto the same concepts. The origin of this social crystalization, he goes on to explain , lies in the fact that the meaning-sound mapping is the same for all the individuals sharing a language, because there is a coordination faculty that makes such coordination possible.

Some years later, in 1933, the american linguist Leonard Bloomfield in his *Language*, a work resting on Saussure, emphasized more than Saussure that language is a coordination problem between sound and meaning, and that this coordination " makes

¹ F. de Saussure, *Cours*, Introd. III, § 2 : " [*La langue*] *n'existe qu'en vertu d'un sorte de contrat passé entre les membres de la communauté* " .

²Strictly speaking, it is a mental representation of the articulated sounds what is mapped into a concept or meaning. Both sound and meaning have a mental reality.

it possible for man to interact with great precision “. He bolstered Smith’s speculation on the relatedness of language to the division of labor, when he asserted that language always accompanies every human action.

Bloomfield argues that:

“ In the ideal case, within a group of people who speak to each other, each person has as its disposal the strength and skill of every person in the group.. The more these persons differ as to special skills, the wider a range of power does each one person control. The division of labor, and with it, the whole working of human society, is due to language “.(Bloomfield, 1933, p. 24)

Bloomfield’s approach to the function of language calls to mind Smith’s speculation on language and division of labor. As economist Karl Wärneryd remarked, there is no logical reason to expect that language is what makes possible the exchange ³ . For one thing division of labor -- although not as in humans -- occurs in animals without a complex language as in ants , wasps, bees and wolf packs ⁴ . Specialization in social insects is so surprising that Dawkins (1989,p.180) asserts that these insects discovered - before man ! - that cultivation of food is more efficient than hunting-gathering⁵ . Therefore it is difficult to attribute the faculty of language the main

³ Wärneryd (1995) tackles the relationship between exchange and language in a different but insightful way .

⁴ Smith’s omission of social features of insects was noticed by Hendrik Houthakker , “ Economics and Biology : Specialization and Speciation “, *Kyklos*, 9-2 ,pp.181-1897, (1956). Recently, zoologist L. David Mech has added more evidence on the division of labor in wolf packs : “ The typical wolf pack, then, should be viewed as a family with adult parents guiding the activities of the group and sharing group leadership in a division-of-labor system in which the female predominates primarily in such activities as pup care and defense and the male primarily during foraging and food provisioning and travels associated with them “. L. David Mech “ Alpha status, dominance and division of labor in wolf packs “, *Canadian Journal of Zoology* , 77:1196-1203, (1999, p.1202).

⁵ Slavery, warfare, and robbery can be found among social insects as well as in humans. See W.D. Hamilton (1995, p.216.

motivation that led to the division of labor ⁶.

As the division of labor may occur without language, it would behove us to look back to trade, or to the deliberate exchange of goods as a reasonable hypothesis to explain how language originated and acquired its properties.

⁶ Also L.von Mises asserted that the division of labor makes man distinct from animals: "It is the division of labor that has made feeble man, far inferior to most animals in physical strength, the lord of earth and the creator of the marvels of technology ".L.von Mises,2005, p.18). Notwithstanding the core role of the division of labour, neoclassical and modern economists have observed that Smith's theory would lead to an organization of the market dominated by increasing returns, which is not borne out; see Buchanan (1999)

In a recent paper, Horan et al. (2005) developed a mathematical model (“Shogren’s model “) to explain why Neanderthal man went extinct while coexisting with *Homo sapiens*. The title of their paper is fairly suggestive to my own present purpose: “ *How Trade⁷ Saved Humanity from Biological Exclusion...*”. They explore two hypotheses : biological exclusion and behavioral exclusion.

Biological exclusion predicts that the neandertal extinction would have been slower than it actually was. Also, if neandertals were biologically more efficient, Shogren’s model predicts, contrary to fact, that humans would not have coexisted with Neandertals.

The reason why humans survived, although they were biologically inferior to Neanderthals, is better explained by the behavioral exclusion theory. Behavioral exclusion theory proposes that humans survived due to the division of labor and specialization, which Neanderthals lacked. The most plausible scenario envisaged by Shogren’s model is one in which there is complete division of labor within two groups of humans: skilled hunters that harvested meat and unskilled hunters who produced other goods. Incidentally, notice that these two groups of humans were already envisioned by Smith in the *Wealth of Nations* I.ii.3⁸

Even with a modicum of trade in NeandertHals, humans overcame them. Their model

⁷ Trade means in Shogren’s model “ exchange “ , be it voluntary or involuntary (centralized o dictatorial) .

⁸ “ In a tribe of hunters or sepherds a particular person makes bows and arrows, for example, with more readiness and dexterity than any other. He frequently exchanges them for cattle or for venison with his companions; and he finds at last that he can in this manner get more cattle and venison, than if he himself went to the field to catch them “ (A. Smith, 1776,I.ii.3)

proves that humans survived neandertals because of the availability of meat consumption was greater due to the division of labor. Horan et al. (2005,p.21) conclude their paper noticing that *“A crucial issue remains unresolved: it is an open question why the early humans first realized the competitive edge from trade. Some attribute the edge to differences in cognition or language abilities or both, but the jury is still out . “*

The issue may be elucidated by looking into Neandertal language. As there is no evidence that Neanderthals had a complex language as there is of early humans ⁹, the hypothesis that the competitive edge could be realized by developing abstract symbols becomes compelling. The conclusion then that language and trade coexisted seems inescapable . It seems reasonable that all cognitive capacities involved in trade (such as the designing of tools for manufacturing exchangeable goods, the exchange value of goods , and the ability to make decisions on goods) should be observable in language.

The next step involves determining which came first, language or trade ?

Although no definite answer can be given, some logical priority goes to trade . Three arguments may be adduced. First, language is a necessary condition neither for the division of labor nor for trade .In the Shogren - Smith model, it is meat consumption and a previous division among members of the tribe (skilled versus unskilled individuals) that triggered the division of labor. According to Shogren, the assumption that early humans were more skilled hunters than neandertals, allowed them to produce meat enough to exchange for goods produced by unskilled hunters.

Second, as language basically involves coordination problems, just as trade and the division of labor do, it is plausible to assume that language depends on trade and the division of labor as well as on the more complex social relations added by trade. The

⁹ There has been a hot debate on the issue of neandertal language. The issue has been settled by P. Lieberman, *The Biology and Evolution of Language*, Cambr., Mass.: Harvard University Press, 1984 and S. Mithen, *The Singing Neanderthals: The Origins of Music, Language, Mind and Body*, Camb., Mass.:Harvard University Press, 2006, p.221, who argue that neandertals at most had an inferior linguistic capacity than *Homo sapiens*. It should be emphasized that no real evidence for a neandertal language has been offered.

ground for this dependency lies in the fact that the division of labor leads to coordination between (at least) two individuals thus incurring external coordination Costs (Houthakker, 1956) . Then language could have evolved in order to set off such costs.

The third argument is that some games can be played (or preplayed) using communication, and in particular cheap talk , which does not add more or less value to payoffs.

So trade may occur without language, but language must be motivated., in the sense that a speaker S sends a message μ to a receiver R with a particular intention.

The scenario set up by trading can boost a symbolic communication system as rich as modern human language. Karl Wärneryd (1995) addresses the role of language in economic activities reminding that neoclassical economists start from the premise that exchange follows from the well-defined preferences of individuals with a basket of consumption goods . When preferences (or payoffs) are in equilibrium, however, it may occur that some equilibria are more efficient and stable than others. Communication selects the more efficient equilibrium if it is costless. Exchange , then, triggers or motivates language, not the other way around. Consequently, if animals do not have full symbolic communication it's because they do not exchange goods , which motivates the existence of a language ¹⁰. Smith's dog has not evolved language because that would require exchange and coordination . As he has nothing to coordinate, he needs no language . The dog is tied to its costly signals.

I will conclude, then, that trade is a robust candidate for the origins of a modern symbolic language.

¹⁰ W.D. Hamilton (1995, p.342) makes a case for the idea that tools and language confer benefits to a cooperative hunter .

4. 2 Games and Symbols

Next, I will take up a subset of Hockett's design features and show how they fit into the coordination game framework . We should bear in mind the main difference between traditional game theory and coordination game theory : the former deals with winning strategies, solutions concepts and equilibria , and the latter deals with players' common interests strategies and possibly multiple equilibria. Consequently, players in common interest games use of cognitive strategies such as imitation, analogy, reasoning , guessing, imagination, common knowledge .

Design features are understood as properties that characterize language as a communication system to compare language to signals of other nonhuman communication systems. For the moment, I will ignore animal signals and focus on linguistics symbols as originated in the coordination game of trade and the division of labor. I deal with the following design features proposed by Hockett ¹¹ : Duality , Semanticity, Parity, Specialization, Prevarication, Cultural transmission., and Displacement of Reference.

Let's look at each of these features to see how they might be construed as games.

4.2.1 Duality

Def.(Saussure, Course de Ling. Gen. I.1. §1) “ The linguistic sign [i. e. symbol] is a mental entity with two faces : a concept [meaning] and an acoustic image [sound] .

¹¹ Some of these features were previously studied by Saussure , Bloomfield and Martinet , but are known as Hockett's design features; C.F. Hockett, “ Logical Considerations in the Study of Animal Communication”, in: W. F. Lanyon and W.N. Tavolga, eds, *Animal Sounds and Communication*, Washington, Am. Inst. of Bio. Stud., Sympos. Ser. 7, (1960), 392-430.

These two elements are tightly joined and one demands the other[bidirectional mapping] ” .Idem I.1. §2 : “ The tie [the mapping] joining meaning and sound is arbitrary “ .

The first conundrum that the saussurean sign poses is a coordination problem. In order to communicate, the agents or the speakers of a community must make the same associations between sound and meaning. Such coordination is solved by means of a coordination game ¹² between meaning and sound . It must be noticed that Saussure (*Cours*, Intro. III. § 2) put forth that speakers in a population P must be endowed with “ receptive and coordinating faculties “ to attain the same one-to-one mapping. Therefore meaning and sound must be coordinated in a communicating population P of senders / receivers because both meaning and sound are unattached to each other. Meaning of sign S_1 could ,a priori, be attached to any other string of sounds σ_n and vice versa. This coordination problem can thus be formulated in the following way : how do sender and receiver of a message assign the same bidirectional mapping from meaning into sound and from sound into meaning ?

As all members of the population P want to use the same signs to communicate ,they all share a common interest and therefore must coordinate their choice. This is in essence a coordination game, in the sense of Schelling . More specifically, he characterizes a coordination game as follows:

- (1) Players' preferences are identical, so there is no conflict of interest
- (2) Each player's best choice depends on the action he expects the other to take, which in turn depends on the other's expectations of his own. In other words, the game is based upon the players' mutual expectations.
- (3) The players' goal is to share some common- interest activity by means of a cognitive process (such as imagination, poetry and humor). In the case of language, players want to use the same signs to communicate with each other.

¹² Wittgenstein's language games may be construed as coordination games. See L. Wittgenstein, *Philosophische Untersuchungen* , §§2, 8, 21, 48-51.

Let's look at table 1. One player chooses a Row and other player chooses a Column. Row and Column represent tacit processes determining the payoffs. Since unlike in zero sum game the players' goal is not but to share some common interest by tacitly searching through cognitive processes, payoffs only represent the degree of coordination attained by the players¹³. So the payoff matrix for a coordination game is different from zero sum games and nonzero sum games. If players combine $\langle R1, C1 \rangle$ they are better off than combining $\langle R1, C2 \rangle$ and better off than combining $\langle R2, C1 \rangle$ and so on. As it is possible that whenever choosing one Row and choosing one Column players "win", that is, they guess what each other is thinking, this winning results $\langle 1, 1 \rangle$ can be arranged in a diagonal line.

¹³ Such processes may equal to the usual strategies in conflict games, but contrary to conflict games, no minimax solution exists for them.

	C1	C2	C3	C4	C5
1	1 1	0 0	0 0	0 0	0 0
0	0 0	1 1	0 0	0 0	0 0
0	0 0	0 0	1 1	0 0	0 0
0	0 0	0 0	0 0	1 1	0 0
0	0 0	0 0	0 0	0 0	1 1

Table 1

(Lower left entry in cells is payoff to row-player, upper right is payoff to column-player)

Let's get back now to design features of language. Duality is conceived in Saussure's sense as a bidirectional mapping from sound and meaning such that both sound and meaning are autonomous of each other but must be coordinated by the senders and the receivers in order for them to attain optimal communication . What cognitive strategies are involved in duality ? Some tacit strategies that come to mind are Random mapping, Imitation , Probabilistic mapping , and knowledge of convention in the sense of David Lewis (1969) .

Linguistic conventions are not explicit but tacit agreements. This means that speakers must use cognitive strategies to coordinate sound and meaning. Convention can be arrived at by calling on a variety of such strategies. Saussure assumed the existence of a coordinative capacity in man. This assumption , however, sets up a circular argument.

A much more adequate explanation is provided by Lewis' convention.

4.2.2 Semantics

Def. "The elements of a communicative system [linguistic symbols] have associative ties with things and situations, or types of things and situations, in the environment of its users... such ties are semantic conventions shared by speakers" (Hockett, 1960, 41)

The bidirectional mapping sound-meaning should be distinguished from the mapping symbol - denotation (things, situations, or simply, actions). Adopting a Lewisian theory of meaning, symbols (or signals in the sense of game theory) are mapped into actions so that actions can be true or false if they establish a coordinating equilibrium. Table 4.2 shows such equilibrium. Signal A means (is mapped onto) action X, with payoff (1,1), while signal B means action Y with payoff (1,1). Mapping is established by convention.

		Receiver	
		Action	
		X	Y
Sender signal type	A	1,1	0,0
	B	0,0	1,1

Table 4.2

4.2.3 Interchangeability (parity)

Def. "Adult members of any speech community are interchangeably transmitters and receivers of linguistic signals" (Hockett, 1960, 155)

This feature derives from the definition of a coordination game without proof, as this game is played by pairs of speakers. Yet parity has been challenged by rationalist philosophers and linguists. Rationalist claim that language is used only for the

expression and representation of thought , not for social communication. However, the game- theoretic approach to language requires that language be strictly used and motivated for the communication of intentions. Besides, this should be taken not only as its current function, but as the original function ¹⁴. Since the communicative function overrides the representational function in efficiency of coordination, the claim that language is for the expression of thought is not motivated by game theory, Communication, not expression of thinking, subserves coordination.

4.2.4 Specialization

Def.: “ A communicative act, or a whole communicative system, is specialized to the extent that its direct energetic consequences are biologically irrelevant . Obviously language is a specialized communicative system. “ (Hockett, 1960, p. 139)

¹⁴ Assuming that communication is both the original and the current function of language avoids the issue (for which Darwinism lacks an adequate response) of how an original organ transforms its original function into another function, contrary to N. Chomsky that asserts that we don't know the original purpose of language, although he assumes a transformation of the original function into the “ expression of thought “ function; Kirschner and Gerhart (2005) and Hauser et al. (2002).

Contrary to human language, animal signals have direct biological consequences as well as energetic costs . In insects, signals (calls and songs) emitted by a male insect serve to attract females as sexual mates ¹⁵ . The bees' dance informs only about the food source ¹⁶ . Also birds' alarm signals alert other conspecifics to flee. The bird that warns its conspecifics by emitting an alarm call is in grave danger of dying because it attracts the predator's attention. This shows that communicative behaviour in animals adopts strategies that incur costs and benefits , just as in the conflict of interest game.

Dawkins points out that “ the belief that animal communication signals originally evolve to foster mutual benefits, is too simple “ . Rather, he continues, “ all animal interactions involve at least some conflict of interest “ (Dawkins, 1989,pp.68-87). Since linguistic communication is basically a coordination game, it is costless or cheap; costs and benefits of sending and receiving signals are irrelevant . Language, then, may be conceived as a signalling game, where both sender and receiver obtain equal payoffs because they share the same interests¹⁷ . Moreover, animals signals may be dishonest, while language lacks dishonest signals. Language evolved for coordination, which sets a barrier for a strict Darwinian view of language origins ¹⁸.

4. 2. 5 Prevarication

Def. “ Linguistic messages can be false, and they can be meaningless in the logicien's sense. “ (Hockett, 1963, p. 14)

¹⁵ H. Carl Gerhardt and Franz Huber, *Acoustic Communication in Insects and Anurans*, The University of Chicago Press, 2002, observed that some insects lose weight during call transmission.

¹⁶ For these and other examples of animal calls , see R. Dawkins, *The Selfish Gene*, Oxford University Press, Oxford University Press, 1989.

¹⁷ Otherwise said, the utility function of Sender $u(s)$ and Receiver $u(a)$ are equal.

¹⁸ Because linguistic communication is a pure coordination, mass phenomenon (individuals being genetically unrelated), it presents a real conundrum for natural selection account of language origins and evolution, concerning individuals and genes . For instance Pinker (1995) does not take up these issues.

One of the main differences between animal signals and linguistic symbols is in animal's signals communication being truthful, while communication by linguistic symbols possibly not. Signals correspond to a set of fixed states either of the animal type (hunger, sex) or the environmental type (danger). Therefore, prevarication or lying is not a real option for animals¹⁹. However, the possibility of the receiver being manipulated by the sender has been emphasized as an option in animal communication (Dawkins, 1989, p.64). On the other hand, linguistic communication assumes truthful messages sent by truthful senders. This is called the "truth bias" by game theorists. The speaker, in turn, is committed to the truth of his messages.

The nature of lying is due to the symbolic character of human communication comprising conventionality and unboundedness. Biologically, lying is a cost for a symbolic system because it contributes to the selfish and parasitical, but non-coordinating behavior (Hamilton, 1995, p.132).

Game theory recognises both the existence of lying and "The Decay of Lying", as Oscar Wilde put it in this comedy²⁰. Lying is a kind of behavior that fits into a two person partial-interest game, that is, a game in which some agent is coordinating non-

¹⁹ W. D. Hamilton (1995, p.218) who writes on "Selection of selfish and altruistic behavior in some extreme models", remarks that "by our lofty standards, animals are poor liars"; In turn, Karl Popper (1974, p. 1112-3) suggested that "human language evolved because it made lying possible".

²⁰ Wilde's words wittily express the nonpredominance of lying: "With the possible exceptions of barristers, lying as an art has decayed." On lying as a game see Wittgenstein (1953, § 249).

strictly . Table 4. 3 represents such a game in which the sender sends a signal which triggers a best action by receiver

		Receiver		
		Action		
		X	Y	Z
Sender signal type	A	4,4	1,1	6, 3
	B	1,1	4, 4	6, 3

Table 3

Partial interest game (lying)

This matrix enlists values of common interests as well as of conflict of interests. The combinations $\langle A, Z \rangle = (6, 3)$ and combination $\langle B, Z \rangle$ represent the case in which the sender has obtained a profit over the receiver²¹ .

Note, however, that lying is violates linguistic conventions, but these conventions can't be associated with lying because there would then be a winning strategy for the receivers such as " If the sender lies –using a lying strategy – do not act as sender expects " . Thus a better and winning strategy would eventually evolve. Therefore, one can deduce that lying cannot be evolutionary stable (Dawkins, 1989,p.77).This evolutionary game explains why there are no markers (conventions) for lying in human languages.

4.2. 6 Cultural transmission

Def. " The continuity of language from generation to generation is provided by

²¹ Experimental work by Kawagoe & Takizawa (2005) shows that lying pays as well as the truth bias of agents.

tradition. All traditional behaviour is learned [from others]. Tradition becomes transformed into cultural transmission when the passing down of traditional habits is mediated by symbols. “ (Hockett, 1960, p. 155)

Symbols are learned from generations to generations, and they grammatical patterns . Linguists and psychologists argue whether an innate , not culturally but genetically transmitted device exists that makes learning of grammar possible. Supporters of an innate device assume the existence of an absolute invariant²² Universal Grammar (UG) genetically transmitted that would explain language learning with no resort to cultural transmission.UG is conceived as a random generator device or an automaton.

The UG hypothesis , however, has not found observable or empirical universals that account for overt and regular crosslinguistic variation ²³.

A different way to tackle regular variations, (sometimes termed Greenberg universals), is to look at it as a coordination game problem in Schelling's sense. Language learning requires the input from the community . All learners must converge on the input grammar, that is, they must coordinate their grammars with those of the input. When coordination problems persist among members of a community, that community yields regular patterns to solving such problems or otherwise adopt them from other communities (for example, by cultural diffusion). These regular patterns turn into

²² Note, however, that is false in a strict (neo)darwinian view.

²³ Universals of the kind required by supporters of the random generator view of universal grammar are located at the biological (brain) level of inquiry, skipping most of overt linguistic properties and offering no general account of crosslinguistic variation. At present such universals are missing, apart from the automaton.

common knowledge within the community²⁴. Note also that in a coordination game an agent selects an action in an undetermined way within a bounded set. Thus using a bounded number of actions we expect different conventions for different communities. In fact, some computational models of language evolution suggest that overt empirical universals arise out of multiagents that evolve across generations (Kirby & Hurford 2001). Here linguistic generalizations (grammatical rules) emerge from cultural transmission, making the assumption of innate Universal Grammar unnecessary.

4.2. 7 Displacement of reference.

Def. : “If we had perfect definitions [of words] , we should still discover that during many utterances the speaker was not at all in the situation which we had defined. People very often utter a word like *apple* when no apple at all is present . We may call this *displaced speech* . The frequency and importance of displaced speech is obvious. Relayed speech embodies a very important use of language: speaker A sees some apples and mentions them to speaker B, who has not seen them; speaker B relays this news to C, C to D, D to E and so on, and it may be that none of these persons has seen them, when finally speaker goes and eats some. In other ways, too, we utter linguistic forms when the typical stimulus is absent . “ (Bloomfield, 1933, p. 141)

The displacement of reference has been taken to be a key property of language. Chomsky (1966) highlights displacement under the “ absence from stimulus “ argument, which he uses against the behavioural account of language use. Displacement (or absence of stimulus) can be derived from (i) semanticity and (ii) specialization. As we have seen, semanticity is the result of conventions under a coordinating equilibrium, while specialization yields costless communication (cheap talk

²⁴ Lewis (1969) adopted such a view which can be extended to the realms of language learning and language evolution.

) . Semanticity provides for conventional and arbitrary symbols that can be stored in memory, while specialization makes cheap the use of symbols so that agent A can relay information (at no cost) to agent B, agent B to agent C and so on, so that the whole population of agents can exchange information not perceived at the moment of the utterance.

The fact that symbols can be relayed accounts for one crucial property of language: sentence recursion. If agent A relays to B “ John ran away “, B can relay this information to agent C as embedded into another symbol : B says : “ John ran away”, and C relays to D : B says “ A says “ John ran away “ ”, and so on. Recursion , then, is a property that emerges from displaced reference , and is not imposed by Universal Grammar. The case in which knowledge of an event is acquired from hearsay (i. e. displaced from the speaker) sets up the evidential modality. Some languages morphologically mark events known from evidence acquired in this way. Thus Tunica, Bulgarian, and Kwakiutl - among a wide set of languages- use evidentiality markers to signal that the speaker knows the information from others. Other linguistic processes are direct consequences of displaced reference such as indirect questions, quoted speech, discourse representation discourse or free indirect discourse. Moreover, displacement adds a significant edge to a population of agents using referential symbols : it spares time invested in searching for information that otherwise an agent needs to obtain in the presence of stimulus. The spared time can be invested in other activities increasing the number of activities that the population can engage in. Displacement increases the production possibility curve ²⁵ .

4.3. Conclusions.

²⁵ I deal with time allocation related to displacement in : A. Alonso-Cortés y F. Cabri- llo, *The Economics of Language: A Coordination Game Approach*, ms. UCM, Madrid, 2006.

Language and trade are related to each other because both involve the kinds of exchange problems that may be solved by coordination games. Modern symbolic language might have been boosted as a tool to set off external coordination costs incurred by trade (goods exchange) in modern human populations. From coordination games and a cost - benefit analysis one can derive a subset of design features of language. Some significant and crucial features of language such as duality, semanticity, displacement of reference and prevarication are a direct consequence of coordination among members of a population, while coordination through evolutionary games account for cultural transmission.

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